

## FOOD AND FEEDING HABITS OF THE SPECKLED SHRIMP *METAPENAEUS MONOCEROS* (FABRICIUS)

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### ABSTRACT

The food and feeding habits of *Metapenaeus monoceros* (Fabricius) from Cochin region are given in detail in this paper. Differences in food preference for this species had been noticed between marine and brackishwater environment. While *M. monoceros* from inshore grounds preferred polychaetes as their main food item, in Cochin backwaters, they mainly fed on crustaceans. Diurnal variation in the feeding intensity was noticed, where, *M. monoceros* fed more in nights than the day hours. Females in different stages of maturity were found to feed more vigorously than the immature ones. Juveniles and adults in the inshore waters did not show any significant difference in their food preferences. The present study shows that *M. monoceros* is carnivorous, mainly depending on animal food items, irrespective of size and sex in marine as well as estuarine conditions.

### INTRODUCTION

STUDY of food and feeding and assimilation are of fundamental importance in understanding the rate of growth, population concentration, gonadal maturation and other metabolic activities. In general penaeid prawns have been described as 'Omnivorous scavengers' or detritus feeders. Young (1959) has published a description of the gut of *Penaeus setiferus*. The overall structure differs little in the shallow water penaeid except in details of the gastric mill (Dall, 1957) *Penaeus* spp. differs from the *Metapenaeus* spp only in the structure of posterior diverticulum of the midgut; it is compact in *Penaeus* species and longitudinal and simple structure in *Metapenaeus* spp.

Detailed studies have been made in India on food and feeding habits of *Metapenaeus dobsoni* (Menon 1951), *Penaeus indicus* (Gopalakrishnan, 1952), *P. monodon* (Thomas, 1972; Mohanty, 1975) and *P. semisulcatus* (Thomas, 1980). Panikkar (1952), Panikkar and Menon (1956), Kunju (1967) George (1959). Kuttyamma (1974) and Subramanyam and

Ganapathi (1975) have mentioned the food of some penaeid prawns while studying their biology. The food and feeding habits of *M. monoceros* from Cochin backwaters and Godavari estuarine system were studied by George (1974) and Subrahmanyam (1973) respectively. Rao (1988) made studies on the feeding biology of *M. monoceros* from Kakinada coast during 1974-75. Williams (1955) and Eldred *et al.* (1961) studied the food habits of North-American penaeid prawns i.e. *P. setiferus*, *P. aztecus* and *P. duorarum* while Hall (1962) and Dall (1968) investigated the food and feeding habits of Indo-West Pacific penaeid prawns and Australian penaeid shrimps respectively. Tiews *et al* (1968) studied the gut contents of some penaeid species from Manila and San Miguel Bays. The feeding habits and the seasonal variations in feeding habits of *P. monodon* were studied by Marte (1980, 1982) from Phillipine region. In the present paper food and feeding habits of, *M. monoceros* from the fishing grounds off Cochin as well as from Cochin backwaters are given.

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## MATERIAL AND METHODS

Regular samples of *M. monoceros* collected from trawl catches at Cochin Fisheries Harbour and stake net catches of Cochin backwaters during 1991 were analysed to study the food and feeding habits of this species. It is very difficult to identify the food items

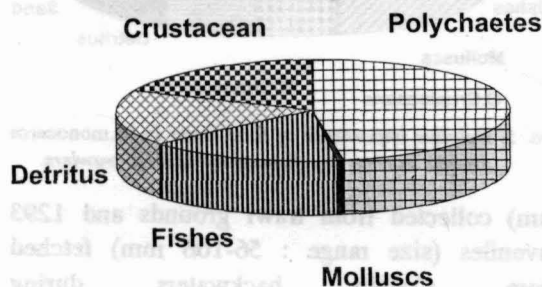


FIG. 1. Relative importance of major groups of food items in *M. monoceros* from trawl landings at Cochin Fisheries Harbour during 1991.

species-wise due to the nibbling action of mandibles on the food and mastication of food inside the stomach by the action of gastric mill. The identification of food organisms were based mainly on broken shell remains, spines, setae etc. The gut contents were grouped as follows: polychaetes, prawns, fishes, molluscs, other crustaceans (consisting mostly, small crab

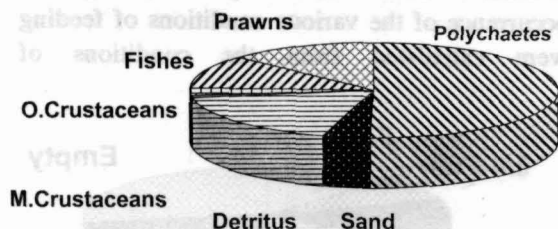


FIG. 2. Relative importance of food items of juveniles of *M. monoceros* from trawl landings at Cochin Fisheries Harbour during 1991.

bits, mysid bits and other unidentifiable crustacean bits), minor crustaceans (mainly amphipods and sometimes isopods and rarely tanaedaceans) and detritus (decomposed plant and animal matter and their remains mixed with mud).

Various methods are in prevalence in the studies of stomach analysis of fishes and these

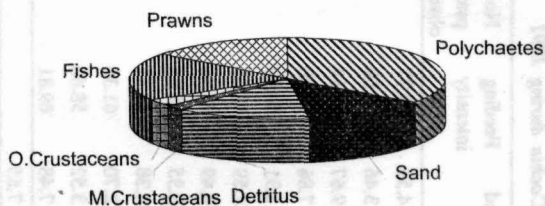


FIG. 3. Relative importance of food items of *M. monoceros* (adults) from trawl landings at Cochin Fisheries Harbour during 1991.

were critically discussed by Hynes (1950) and Pillay (1952). Since the quantity of food in the stomach of prawns is very little, instead of volumetric method the points (volumetric) method (Pillay, 1952) was utilised for studies on the food and feeding habits of *M. monoceros*. In order to get a summary picture of frequency of occurrence as well as volume of various items Natarajan and Jhingaran (1961) devised a method called 'Index of Preponderance' for studying the food and feeding habits of fishes. This method was adopted here for studying the food and feeding habits of *M. monoceros*. Food

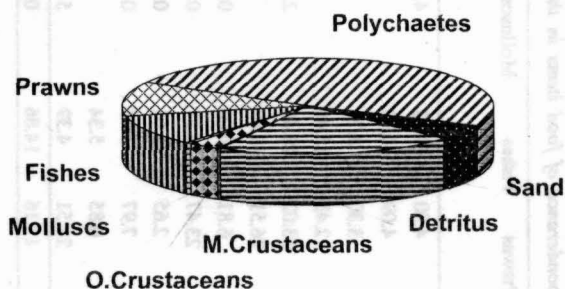


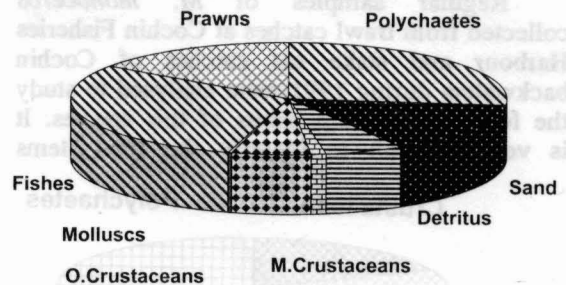
FIG. 4. Relative importance of food items in *M. monoceros* caught during night fishing by shrimp trawlers.

and feeding habits of *P. semisulcatus* in Palk Bay and Gulf of Mannar and of *M. monoceros* along the Kakinada coast were studied by using the method of Index of Preponderance by Thomas (1980) and Rao (1988) respectively.

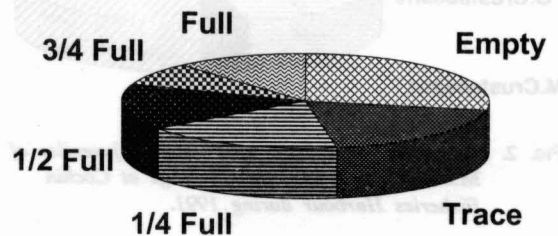
TABLE 1. Index of Preponderance of food items in the stomach contents of *M. monoceros* in the trawl landings at Cochin during 1991

Months	Polychaetes	Prawns	Fishes	Molluscs	Other crustaceans	Minor crustaceans	Detritus	Foramini-ferans	Sand	Feeding intensity	No. of prawns observed
January	21.15	4.30	19.53	4.87	0.74	-	44.85	0.03	4.53	69.77	43
February	62.91	4.09	4.30	-	0.60	0.17	24.36	0.11	3.46	77.59	56
March	52.34	3.30	3.71	-	3.52	0.45	26.92	0.09	9.67	57.14	50
April	15.56	12.43	15.46	-	3.92	3.49	41.28	-	7.86	50.00	51
May	8.42	53.02	28.40	2.00	3.41	0.13	3.31	-	1.31	54.00	47
June	7.10	26.51	48.09	-	1.25	2.06	2.40	-	12.59	52.63	50
July	58.71	6.81	0.06	0.28	0.03	1.34	13.28	-	19.49	42.86	22
August	9.65	23.47	24.31	0.40	1.53	0.46	6.83	-	33.35	8.62	24
September	40.33	2.65	26.61	0.25	1.90	19.64	4.13	0.11	4.38	42.31	45
October	83.07	7.97	2.05	0.19	0.81	0.02	3.19	-	2.70	61.36	37
November	84.99	0.85	5.34	-	0.80	0.51	3.85	0.14	3.52	58.62	24
December	39.76	21.51	4.39	5.76	9.74	0.30	1.06	-	7.48	69.81	42
Total 91	43.76	13.16	14.86	0.54	2.35	1.29	16.36	0.03	7.65		491

In the present study 584 numbers of *M. monoceros* (ranging in size from 52 to 166

FIG. 5. Relative importance of food items in *M. monoceros* caught during day fishing by shrimp trawlers.

mm) collected from trawl grounds and 1293 juveniles (size range : 56-106 mm) fetched from Cochin backwaters during January-December 1991 were subjected for gut content analysis. The intensity of feeding was determined by the degree of distension of the stomach due to the quantity of food inside the anterior and posterior chambers of the proventriculus. The condition of feed was expressed as full, 3/4 full, 1/2 full, 1/4 full, trace and empty and each one was assigned 100, 75, 50, 25, 10 and 0 points respectively. The stomach was cut open and the contents examined under a microscope. Percentages of occurrence of the various conditions of feeding were calculated from the conditions of

FIG. 6. Intensity of feeding in *M. monoceros* caught during day fishing by shrimp trawlers.

individual prawn. Depending on the relative volume of each item, points were given for

each food item and from these, volumes of each food item was calculated. The percentage volume was then computed for the individual items. The percentage occurrences of different

the year 1991, was also calculated taking the total number of prawns examined during the year. The degree of fullness of stomach in relation to size of prawns was noted to study

TABLE 2. Intensity of feeding of *M. monoceros* from inshore waters of Cochin during 1991 in numbers and percentages

Month	Empty	Trace	1/4 full	1/2 full	3/4 full	Full	Actively fed	Poorly Fed	Total No. of prawns observed
January	-	6	7	14	6	10	30	13	43
Nos	-	13.95	16.28	32.56	13.95	23.26	69.77	30.23	
%									
February	2	3	8	7	15	23	45	13	58
Nos	3.45	5.17	13.79	12.07	25.86	39.66	77.59	22.41	
%									
March	6	7	11	16	9	7	32	24	56
Nos	10.72	12.50	19.64	28.57	16.07	12.50	57.14	42.86	
%									
April	5	9	14	7	13	8	28	28	56
Nos	8.93	16.07	25.00	12.50	23.21	14.29	50.00	50.00	
%									
May	3	9	11	11	3	13	27	23	50
Nos	6.00	18.00	22.00	22.00	6.00	26.00	54.00	46.00	
%									
June	7	9	11	12	6	12	30	27	57
Nos	12.28	15.79	19.3	21.05	10.53	21.05	52.63	47.37	
%									
July	6	7	3	4	3	5	12	16	28
Nos	21.43	25.00	10.71	14.29	10.71	17.86	42.86	57.14	
%									
August	34	13	6	3	2	-	5	53	58
Nos	58.62	22.41	10.34	5.17	3.46	-	8.62	91.38	
%									
September	7	9	14	12	4	6	22	30	52
Nos	13.46	17.31	26.92	23.08	7.69	11.54	42.31	57.69	
%									
October	7	7	3	8	4	15	27	17	44
Nos	15.91	5.91	6.82	18.18	9.09	34.09	61.36	38.64	
%									
November	5	3	4	5	5	7	17	12	29
Nos	17.24	10.35	13.79	17.24	17.24	24.14	58.62	41.38	
%									
December	11	3	2	6	13	18	37	16	53
Nos	20.76	5.66	3.77	11.32	24.53	33.96	69.81	30.19	
%									
Jan-Dec'91	93	85	94	105	83	124	312	272	584
Nos	15.92	14.56	16.10	17.98	14.21	21.23	53.42	46.48	
%									

food items were determined from the total number of occurrences of all items in each month. The indices of preponderance were then computed to indicate the food preference of the prawns. The Index of Preponderance for

the intensity of feeding in juveniles and adults in different months. From the total number of prawns examined in a month, the percentage occurrence of stomachs with different intensities of feeding was computed.



## RESULTS

*Food and feeding habits of M. monoceros from shrimp grounds off Cochin*

A critical study on the stomach contents and feeding habits of the brown shrimp from trawl catches landed at Cochin Fisheries Harbour during January-December 1991 was carried out in detail. The particulars on the composition of food during different months, changes in food habits and intensity of feeding between juveniles and adults and changes in feeding habits between day and night time are given in the following few pages.

**Composition of food :** The food items noticed in the stomach in order of abundance were 1) polychaetes 2) detritus 3) fishes 4) prawns 5) sand 6) other crustaceans 7) minor crustaceans 8) molluscs and 9) foraminiferans. The month-wise details on Index of Preponderance (hereafter referred as Index), for each food item as well as the annual Index are given in Table 1.

Polychaetes were the most predominant among the food items and could be easily identified by the presence of setae, jaws and occasional body fragments in the proventriculus. They were present in the stomach throughout the year. Polychaetes ranked first among the food items for seven months (February, March, July, September-December) with Index between 39.76 and 84.99 and they also turned out to be the main food item during 1991 with an Index of 43.76. Detritus ranked second among the food items with an Index of 16.36 in 1991. It ranked first in January and April with an Index of 44.85 and 41.28 respectively and second in the months of February and March and occupied the third position in July and October-December duration.

Fishes constituted third important food item of the brown shrimp during 1991 with an Index of 14.86. They formed the most important food item in June with an Index of

48.09. Mostly very small juvenile fishes were found in the stomachs which were identified due to the presence of vertebrae, scales and spines. Fishes ranked second among the food items in May, August and September and third in January and April. Prawns were observed in the stomach of the speckled prawn throughout the year and ranked 4th in importance among the food items encountered in 1991 with an Index of 13.16. The maximum Index of 53.02 for prawns in the stomach contents was noticed in May. Prawns occupied second position in June, October and December with Index between 7.97 and 26.51 and ranked third in the month of August. In many instances, penaeid prawns in semi-digested condition were found among which species of *Metapenaeopsis*, *Trachypenaeus* could be tentatively identified. *Acetes* species were rarely seen in the stomach contents. From the nature of decapod remains in the stomach, it is likely that the *M. monoceros* may eat exuviae of juvenile prawns along with bottom mud.

Sand was found in the stomach in all months and had an Index of 7.65 in 1991, ranking 5th in abundance. This item was probably an accidental inclusion while the prawn was feeding at the bottom. Other crustaceans consisting mostly small crab bits and other unidentifiable crustacean appendages ranked sixth in abundance with an index of 2.35 in 1991 and were noticed in the stomach throughout the year. Minor crustaceans consisting mostly amphipods and rarely isopods were found in the stomach throughout the year with an exception of January and ranked seventh among the food items. This group ranked third in the month of September with an Index of 19.64. Molluscs gained some importance as a food item of the brown shrimp in the months of January, May and December with an Index between 2.00 and 5.76. Although crushed shells of various forms of lamellibranch mollusc were noticed, the fresh appearance of the shells as well as partly digested flesh indicated that they

were eaten alive. In a few instances calcareous outerbits of oyster shells were also encountered. During 1991, the molluscs ranked 8th among the food items. Foraminiferans were found in very small quantities during January-March and in the months of September and November with an Index between 0.03 and 0.14. They ranked last among the food items in these months as well as in 1991.

To find out the actual indices of relevant food items the Index of sand was deleted and that of foraminifera was included with detritus. Indices of prawns, other crustaceans and minor crustaceans were combined together as crustaceans. Thus the relative importance of polychaetes, fishes, crustaceans, molluscs and detritus was depicted in Figure 1. Polychaetes emerged as the most important food item of *M. monoceros* in the trawling grounds off Cochin, with an Index of 47.38, crustaceans (prawns : 78.35%; other crustaceans : 13.96%; and minor crustaceans 7.69%) ranked second with an Index of 18.19. Detritus occupied third position with an Index of 17.75 among the other food items. The next in importance occupying fourth position were fishes and their food Index was 16.09. The molluscs were ranked last, the Index being 0.59 only.

#### *Food and feeding habits in relation to size*

Samples of *M. monoceros* from trawl grounds were separated as juveniles and adults based on the minimum size at maturity to understand whether any differences existed in their food habits. The minimum size at maturity for males and females were 98 and 104 mm in total length respectively. Males measuring upto 98 mm and females upto 104 mm in total length were grouped as juveniles and beyond these sizes as per sex were considered as adults.

The relative importance of the food items in juveniles and adults of *M. monoceros* is shown in Fig. 2 and 3 respectively. It is clearly seen that polychaetes (Index: 50.18) were the most important food item of juveniles followed

by detritus, prawns and fishes. In the case of adults, even though polychaetes were ranked high among the gut contents their importance came down with a lower Index of 34.92. The other important food items of adult prawns in order of abundance were fishes, prawns and detritus.

#### *Food and feeding habits in relation to day and night fishing*

*M. monoceros* caught during day fishing from June to September 1991 and those from night fishery in other months were compared for studying diurnal variations in food habits. Some important differences in selectivity of food items during day fishery from those of night-fishing were observed. Hence data from these two fishery were treated separately and the relative importance of food items of prawns caught in night and day fishing has been shown in Fig. 4 and 5 respectively. Polychaetes (Index : 48.23) contributed almost half of the food requirements of *M. monoceros* caught at night-time and the other half being shared by detritus, prawns, fishes and other crustaceans. Whereas in day time caught prawns it was clearly seen that fishes contributed about one third of the food requirements; and polychaetes, prawns, minor crustaceans, detritus and sand particles contributed to the remaining two third of stomach contents.

#### *The feeding intensity*

Details on the feeding intensity in numbers and percentages are given in Table 2. Prawns with 'full', '3/4 full', '1/2 full' stomachs were considered as actively fed while '1/4 full', 'trace' and 'empty' stomachs were taken as poorly fed. The percentage of actively fed prawns from the trawling grounds off Cochin during 1991 was 53.42. The maximum numbers of actively fed prawns (77.59%) were recorded in February '91 while the minimum numbers (8.62%) were noticed in the month of August. Feeding intensity in females (57.95%) was more

than males (48.58%) during 1991 (Table 3.) The maximum feeding intensity in both sexes was noticed in February which was 93.33% for females and 60.71% for males.

Feeding intensities (in numbers and percentages) of 199 female *M. monoceros* with stages of maturity are shown in Table 4. *M. monoceros* in late maturing stage was found to feed very

TABLE 3. Feeding intensity of females and males of *M. monoceros* from Cochin trawl grounds during 1991

Month	Actively fed		Poorly fed		Combined		Total No. of prawns observed
	Female	Male	Female	Male	Actively fed	Poorly fed	
January	82.61	55.00	17.39	45.00	69.77	30.23	43
February	93.33	60.71	6.67	39.29	77.59	22.41	58
March	69.70	39.13	30.30	60.87	57.14	42.86	56
April	60.71	39.29	39.29	60.71	50.00	50.00	56
May	53.33	54.29	46.67	45.71	54.00	46.00	50
June	48.57	59.09	51.43	40.91	52.63	47.37	57
July	44.44	42.11	55.56	57.89	42.86	57.14	28
August	2.70	19.05	97.30	80.95	8.62	91.38	58
September	46.15	38.46	53.85	61.54	42.31	57.69	52
October	65.22	57.14	34.78	42.86	61.36	38.64	44
November	60.00	57.14	40.00	42.86	58.62	41.38	29
December	78.57	60.00	21.43	40.00	69.81	30.19	53
Annual %	57.95	48.58	42.05	51.42	53.42	46.58	584

TABLE 4. Feeding intensity of female *M. monoceros* in different stages of maturity with percentages in parenthesis

Stages of Maturity	Empty	Trace	1/4 full	1/2 full	3/4 full	Full	Poorly fed	Actively, fed	Total No. of Prawns
Immature	21 (34.42)	4 (6.56)	3 (4.92)	3 (4.92)	11 (18.03)	19 (31.15)	28 (45.90)	33 (54.10)	61
Early maturing	2 (9.09)	2 (9.09)	2 (9.09)	8 (36.37)	2 (9.09)	6 (27.27)	6 (27.27)	16 (72.73)	22
Late maturing	-	-	5 (18.52)	8 (29.62)	7 (25.93)	7 (25.93)	5 (18.52)	22 (81.48)	27
Mature	-	-	11 (32.35)	7 (20.59)	6 (17.65)	10 (29.41)	11 (32.35)	23 (67.65)	34
Spent	2 (3.64)	8 (14.54)	6 (10.91)	12 (21.82)	11 (20.00)	16 (29.09)	16 (29.09)	39 (70.91)	55

An attempt was made to find out whether there exists any variation in the feeding activity in females with different maturity conditions.

actively (81.48%). Prawns in other maturity stages also fed actively with their percentages between 67.65 (mature) and 72.73 (early

maturing). Spent females showed 70.91% feeding intensity. The average feeding intensity of females of *M. monoceros* from early maturing to mature condition was 73.49. Immature females showed a feeding intensity of only 54.10%. Thus the onset of maturation increases the inclination of feeding in females.

#### Diurnal variation in intensity of feeding

When the data for day fishing and night fishing for the whole year, were taken into consideration, the following details on intensity of feeding of *M. monoceros* came to light as shown in Fig. 6 and 7 respectively. Prawn with stomachs in 'empty' and 'trace' conditions constituted 47.18 and 22.11% in the day and night fishery respectively. *M. monoceros* with

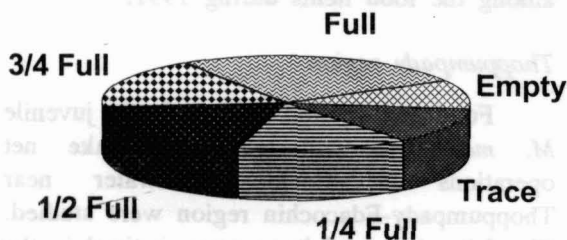


FIG. 7. Intensity of feeding in *M. monoceros* caught during night fishing by shrimp trawlers.

full stomach content formed only 11.79% in the day time fishery while they formed 25.97% in the night fishery. Nearly two third of the *M. monoceros* caught during nights were actively fed while the same amount of them caught in day time were noticed to have fed very poorly. The above observations confirmed that the speckled shrimps feed actively during night time only.

#### Food and feeding habits of speckled shrimps from Cochin backwaters

The food and feeding habits of 603 juvenile *M. monoceros* collected during 1991 from Cochin backwaters at Vypeen and 690 number at Thoppumpady fish landing centres were studied. The prawns were collected live from stake net catches.

#### Vypeen region

The following food items in order of abundance were noticed in the stomach of brown shrimps of Vypeen region (between Coching bar-mouth and Murukkumpadam) 1) *Acetes* spp. 2) prawns 3) other crustaceans 4) minor crustaceans (consisting mainly amphipods and rarely isopods) 5) polychaetes 6) detritus 7) fishes 8) copepods and 9) sand. The Index of Preponderance for individual food item for each month and for the whole year had been shown in Table 5.

*Acetes* spp was the most prominent food item for juvenile *M. monoceros* during January-March and December with maximum index of 90.47 in March. During peak monsoon months (June-August) *Acetes* spp were absent in the stomach contents. In other months the Index varied between 10.98 (September) and 20.24 (May). When the entire sample collected at Vypeen in 1991 were taken into account, the Index of *Acetes* spp was 43.08 ranking first among the stomach contents of juvenile *M. monoceros*. Prawn group containing mainly

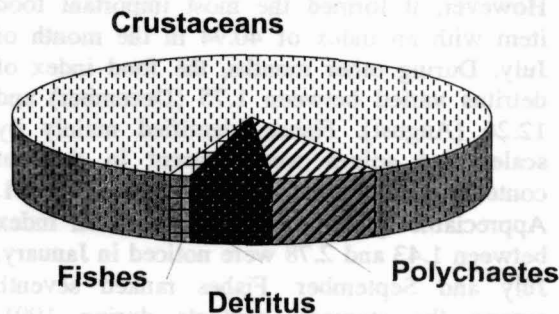


FIG. 8. Relative importance of major food items in *M. monoceros* from Cochin backwaters (Vypeen region).

post-larvae and mysis stages of penaeid prawns ranked first among the food items of *M. monoceros* at Vypeen backwaters in the month of April with an Index of 77.83 and second among the stomach contents in January,



February and August with and Index of 42.80, 27.84 and 28.45 respectively. For the year 1991 prawns ranked second in importance as a food item with an Index of 21.30.

Other crustaceans ranked third in importance during 1991 with an Index of 13.55 and they were present in the stomach throughout the year. They constituted almost the entire food material in the month of June with an index of 91.05 and ranked first with an Index of 60.77 in May. Minor crustaceans ranked first among the food items in September and October with an Index of 35.10 and 35.91 respectively. During 1991 with an average Index of 7.41, they ranked fourth in importance as a food item.

Eventhough present in all months, polychaetes in appreciable quantities were noticed in the stomach contents, only from July to November. They ranked first in the stomach contents in November with an Index of 53.14 and for the year 1991, polychaete occupied fifth position among the stomach contents of *M. monoceros* with an Index of 7.31. Detritus ranked as sixth important food items in 1991. However, it formed the most important food item with an index of 40.94 in the month of July. During other months, the food index of detritus varied between 1.75 (December) and 12.26 (August). Fishes identified mainly by scales and spines were present in the gut contents during most of the months in 1991. Appreciable quantities of them with an Index between 1.43 and 2.78 were noticed in January, July and September. Fishes ranked seventh among the stomach contents during 1991. Copepods were noticed in good quantities in September alone and for the year 1991 they ranked 8th among the food items. Sand particles were encountered more in the month of September with an Index of 6.22 and in other months their occurrence was quite negligible.

Thus *Acetes* spp, prawns, other crustaceans, minor crustaceans, polychaetes with

food Indices of 43.08, 21.30, 13.55, 7.41 and 7.31 respectively formed the important food items of juvenile *M. monoceros* in order of abundance. The relative importance of stomach contents as groups namely, polychaetes, crustaceans, fishes and detritus is shown in Fig. 8 for the year 1991. It is clearly seen from the figurative expression that crustacean group (*Acetes* spp. : 50%; prawns : 25%, other crustaceans : 16 % and minor crustaceans : 9%) contributed to 85.73% of the stomach contents, thus forming the most important food item of juvenile *M. monoceros* at Vypeen. Polychaetes ranked second with and Index of 7.31 followed by detritus (Index : 5.69). Fishes with an Index of 1.27, occupied the last position among the food items during 1991.

#### *Thoppumpady region*

Food and feeding habits of 690 juvenile *M. monoceros* collected from stake net operations at Cochin backwater near Thoppumpady-Edacochin region were studied. The following food items were noticed in the stomach contents in the order of abundance : 1) other crustaceans 2) prawns (mainly mysis stages of penaeid groups, and juvenile *Metapenaeus* spp. and during monsoon season, freshwater prawns mostly, *Palaemon* spp.) 3) Detritus 4) *Acetes* spp. 5) Polychaetes 6) Blue green algae-mainly *Spirogyra* spp. 7) Fishes and 8) minor crustaceans (amphipods and rarely isopods). The detailed informations on Index of Preponderance, (monthwish and annual) for individual food items are given in Table 6.

Other crustaceans were found in the stomach contents throughout the year, 1991, as the most important food item with an annual Index of 38.98. They formed the main food during July-August with an Index of 71.43 in July and 68.44 in August and ranked first among other stomach contents during November-December with an Index of 38.37.

They occupied the second position among the other food items in the months of January, February, March and May with Indices of 52.08, 46.46, 36.19 and 45.51 respectively. They were absent in the stomach during peak

TABLE 5. Index of Preponderance of food items in the stomach content of *M. monoceros* from Cochin backwaters at Vypeen during the year 1991

Months	Polychaetes	Prawns	Fishes	Copepods	Other crustaceans	Minor crustaceans	Detritus	Acetes spp	Spirogyra	Sand
January	0.26	42.80	2.78	-	0.34	0.01	0.34	53.44	-	0.03
February	0.04	27.84	0.07	0.19	20.42	-	7.00	44.44	-	-
March	0.84	5.31	0.48	0.01	0.54	-	1.91	90.47	-	0.44
April	0.46	77.83	0.66	-	0.71	-	0.09	20.10	-	0.14
May	0.38	17.72	0.76	-	60.77	-	0.13	20.24	-	-
June	1.77	6.65	0.44	-	91.05	-	0.09	-	-	-
July	12.74	-	1.43	-	20.52	22.66	40.94	-	-	1.71
August	16.42	28.45	0.12	0.49	39.02	-	12.26	-	2.87	0.37
September	15.19	-	2.29	11.29	8.89	35.10	10.04	10.98	-	6.22
October	31.08	7.11	0.79	1.07	6.31	35.91	6.40	11.33	-	-
November	53.14	4.31	-	-	3.90	13.94	10.34	13.89	-	0.48
December	0.36	0.09	0.39	0.05	2.19	22.36	1.75	72.81	-	-
Total '91	7.31	21.30	1.27	0.39	13.55	7.41	5.31	43.08	0.01	0.37

March, September and October with Indices between 22.33 and 34.25. Prawns occupied second position in importance for this year with an Index of 26.40 and were present in the stomach in all months. They turned out to be the most important food item in the month of April with an Index of 76.56 and ranked second in February. May, June, August, November and December with Indices between 12.18 and 30.23. Detritus ranked first among the food items in September and October with Index of 30.27 and 33.19 respectively and ranked third in importance in the months of February, May, November and December. For the year, 1991 detritus occupied third position in importance with an Index of 13.55.

*Acetes* spp. became the most important food item ranking first in the months of January, February, March and May with Indices of

monsoon months. However, for the entire period of 1991, *Acetes* spp. ranked fourth among the stomach contents with an Index of 12.34. Polychaetes were present in the stomach in appreciable quantities during February-May and July-November periods and ranked fifth (Index : 5.17) among the food items during 1991. Algae represented by the bluegreen filamentous algae - *Spirogyra* was observed to be the most important food in June ranking first with an Index of 72.65. However in July the dependance on *Spirogyra* as food had lessened and it ranked second with an Index of 10.02. *Spirogyra* ranked sixth among the food items during 1991 with an Index of 2.10.

Small juvenile fishes were noticed in appreciable quantities in the stomach of brown shrimp in July, August and October and for the period of observation they ranked seventh

as a food item. Minor crustaceans consisting of mainly amphipods and rarely isopods were seen in the stomach during August-November period and they ranked eight among the food items of *M. monoceros* in 1991. A few numbers of copepods were encountered in the stomach during August-November and sand particles were rarely seen separately among the stomach contents.

For the year 1991, other crustaceans with an Index of 38.98 were the predominant food item followed by prawns with Index of 26.40. Detritus formed the third important food item (Index : 13.55) and the fourth one was *Acetes* spp (Index 12.34). The food items were merged to form important groups to get a clear image on the food preference of these prawns collected from Thoppumpady region (Fig. 9). Crustacean (other crustaceans 50%, prawns 33%, *Acetes* spp. 16% and minor crustaceans 1%) turned out to be the most important food item of

juvenile *M. monoceros* with an index of 78.31. The next important food was detritus with an Index of 13.56. Polychaetes with an index of 5.17 ranked third. Eventhough *Spirogyra* was consumed during monsoon months of June and July only, it was observed to be the fourth important food item (Index : 2.10). Fishes with an Index of 0.86 was ranked as fifth important food item of *M. monoceros*.

#### Feeding intensity

The results on the feeding intensity of *M. monoceros* caught by stake nets from Cochin backwaters, based on the fullness of the stomach did not give a real picture since the prawns remain alive for a few more hours (between 1-5 hours) after their capture in the stake net itself, till they were brought to the shore. This should be the main reason for the feeding activity of juvenile *M. monoceros* from Cochin backwaters to remain below 38% in Thoppumpady and Vypeen centres.

TABLE 6. Index of preponderance of food items in the stomach of *M. monoceros* from Cochin backwaters at Thoppumpadi during the year 1991

Months	Polychaetes	Prawns	Fishes	Copepods	Other crustaceans	Minor crustaceans	Detritus	<i>Acetes</i> spp	<i>Spirogyra</i>	Sand
January	0.02	17.99	-	0.07	26.01	-	3.81	52.08	-	0.02
February	8.27	23.33	-	-	4.44	-	17.50	46.46	-	-
March	3.01	21.62	-	-	34.25	-	4.93	36.19	-	-
April	3.52	76.56	-	-	8.37	-	6.90	4.58	-	0.07
May	2.00	21.79	0.16	-	11.51	-	18.61	45.51	-	0.42
June	-	14.40	-	-	12.10	-	0.85	-	72.65	-
July	9.46	2.46	6.33	-	71.43	-	0.30	-	10.02	-
August	4.65	12.18	11.17	0.12	68.44	1.53	1.91	-	-	-
September	15.54	15.84	0.39	0.03	22.33	5.97	30.27	9.63	-	-
October	14.79	6.23	3.18	0.02	24.57	4.89	33.19	3.11	-	0.02
November	9.03	24.18	0.15	0.10	38.38	1.52	13.78	12.85	-	0.01
December	0.64	30.23	0.28	-	38.37	-	20.16	10.32	-	-
Total '91	5.17	26.40	0.86	0.02	38.98	0.57	13.55	12.34	2.10	0.01

## DISCUSSION

Menon (1951), Gopalakrishnan (1952) and Panikkar and Menon (1956) stated that food of prawns consisted of detritus both animal and plant that accumulate at the bottom of their habitat. Hall (1962) opined that Penaeidae in general cannot be considered detritus feeders and grouped several Malaysian species according to their food preferences. George (1974) stated that juvenile *M.monoceros* from Cochin backwaters is carnivorous and shows preference for small crustaceans such as amphipods, mysids, Tanaidacea, copepods and decopod larvae. Kuttyamma (1974) observed

smaller crustaceans, polychaetes, prawns, detritus, fishes and algae and juvenile from backwaters depended on detritus, other crustaceans algae, copepods, polychaetes, prawns and molluscs. He further stated that juvenile *M.monoceros* was omnivorous but it became carnivorous on attaining adulthood.

In the present study, the following food items were found in the stomach of *M.monoceros* from inshore waters of Cochin in the order of abundance: 1. Polychaetes, 2. detritus, 3. fishes, 4. prawns 5. sand 6. other crustaceans (consisting of crabs, mysids and unidentified crustaceans) 7. minor crustaceans (amphipods) 8. molluscs and 9. foraminiferans. The most important food item was polychaete with food Index of 43.76 and probably due to the browsing habit of the prawn species, detritus (Index : 16.36) had an edge over the other two important food item namely fishes (Index : 14.86) and prawns (Index : 13.16). Females in different maturity stages were found to feed more vigorously than the immature ones. Significant differences in the food preferences were not noticed between the juveniles and adults which agrees well with the observations of Gopalakrishnan (1952) and Thomas (1980). Eldred *et al* (1961) found *P.duorarum* which is also a burrowing species like *M.monoceros* to be mainly nocturnal feeder. Thomas (1980) observed that intensity of feeding in *P.semisulcatus* was better during darker hours of the day. Rao (1988) also observed that feeding intensity in *M.monoceros* was more in the nights. The above said observations agree very well with the present study in which *M.monoceros* was found to feed more intensely during night-time than the day hours.

*M.monoceros* in the Cochin backwaters differ in their food preferences from those from inshore shrimp grounds of Cochin. They fed mainly on crustaceans and the selectivity of food materials differ between places in the same environment. The juveniles from Vypeen region which is in the proximity of the Cochin bar mouth, fed mainly on *Acetes* spp. prawns,

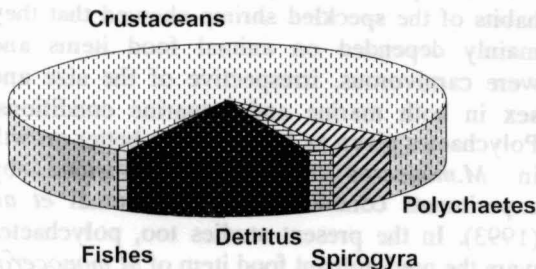


FIG. 9. Relative importance of major food items in *M.monoceros* from Cochin backwaters (Thompumpady region).

that *M.monoceros* (size range 30-128 mm) is omnivorous and fed more on vegetable matter than other penaeid species. Thomas (1972), Kishinoye (1900), Ikematsu (1955), Kubo (1956) and Yasuda (1956) also reported the carnivorous habits of various penaeid prawn species studied by them. The analysis of gut contents of *M.monoceros* from the estuarine and marine conditions by Subrahmanyam (1973) indicated that the most common food items of estuarine prawns were small crustaceans, algae, foraminifera, small molluscs and organic detritus; while the marine prawns subsisted mainly on small crustaceans. Based on detailed studies on the feeding biology of *M.monoceros* along the Kakinada coast during 1974-75 period, Rao (1988) stated that the food of this species in the inshore waters comprised of mainly



other crustaceans, amphipods, polychaetes and detritus in order of abundance during 1991. This prawn species from Thoppumpady-Edacochin region which is about two km from bar mouth preferred mainly other crustaceans, prawns, detritus and *Acetes* spp. However, it was generally observed that in both centres, *Acetes* spp. mostly dominated as food of *M.monoceros* during their peak occurrence in the stake net catches i.e. December-May period. The difference in stomach contents and food preference was mainly due to availability within the ambit of selectivity. This observation agrees with the statement of Tiews *et al* (1968). During peak monsoon months *M.monoceros* survived only on *Spirogyra* spp. at Thoppumpady region. This feeding habit showed their adaptability in unfavourable conditions of non-availability of other preferred food items. Results of the food and feeding studies of juvenile brown shrimps in the Cochin backwaters showed that they are carnivorous which agrees well with the observations of George (1974) in particular and with those made by Subrahmanyam (1967).

*M.monoceros* is one among the important penaeid species utilised for prawn culture practises (Chen, 1976). There is very good scope for this species to be taken up for semi-intensive culture practises in India due to their larger size among the *Metapenaeus* group. In this context the result of the present studies may enable to select suitable food material for the brown shrimp for cultivable purposes. Experiments using different food materials such

as detritus, mangroove leaves, compounded diets etc., were carried out on *M.monoceros* by various research workers (Qasim and Easterson, 1974; Royan *et al.* 1977; Alfred *et al.* 1978; Sumitra Vijayaraghavan *et al* 1978, Ramdhas and Sumitra Vijayaraghavan, 1978). Royan *et al* (1977) after testing food conversion efficiency of *M.monoceros* with different test diets stated that eventhough prawns could survive well on low protein and low caloric diet such as detritus, the conversion efficiency and relative growthrate were high in prawns fed with diets containing 60% protein. Kanazawa *et al.* (1981) stated that *M.monoceros* gave best growth with a diet containing 55% casein.

The present study on food and feeding habits of the speckled shrimp showed that they mainly depended on animal food items and were carnivorous, irrespective of the size and sex in both marine and estuarine conditions. Polychaetes given as food leads to better growth in *M.monoceros* has been confirmed by experiments conducted by Kaliperumal *et al.* (1993). In the present studies too, polychaetes were the predominant food item of *M.monoceros* in marine conditions. Hence results of the present studies enable us to conclude along with other studies that the most suitable food for *M.monoceros* for cultivable purposes should be a combination of crustaceans (*Acetes* spp. prawn, small crabs etc., fishes and annelids (mainly polychaetes) or pelletised feed consisting equal quantity of protein contents.

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